Comparative studies of the field-dependent scanning tunneling spectroscopy in cuprate and iron-pnictide superconductors

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We study the scanning tunneling spectroscopy of hole-type cuprate $YBa_2Cu_3O_{7-\delta}$ (Y-123, $T_c = 93$ K), electron-type cuprate $Sr_{0.9}La_{0.1}CuO_2$ (La-112, $T_c = 43$ K), and "122" iron pnictides $Ba(Fe_{1-x}Co_x)_2As_2$ ($x = 0.06$, 0.08, 0.12 for $T_c = 14$, 24, 20 K). In zero field (H=0), spatially homogeneous coherence peaks at energies $\omega = \pm\Delta_{SC} \sim \pm 21$ meV flanked by spectral "shoulders" at $\pm\Delta_{eff} \sim \pm 38$ meV are found in Y-123. In contrast, only a pair of spatially homogeneous peaks are seen in La-112 at $\pm\Delta_{eff} \sim \pm 13$ meV. For $H > 0$, vortices with a radius much larger than the coherence length ξ_{SC} is found in Y-123, whereas the vortex radius is comparable to ξ_{SC} in La-112. Moreover, pseudogap (Δ_{PG}) features are revealed inside the vortices, with $\Delta_{PG} = \sqrt{\Delta_{eff}^2 - \Delta_{SC}^2} > \Delta_{SC}$ in Y-123 and $\Delta_{PG} < \Delta_{SC}$ in La-112. The Fourier transformation (FT) of the Y-123 spectra exhibits spectral peaks due to ω-dependent quasiparticle interference (QPI) wave-vectors and ω-independent wave-vectors associated with competing orders.[1] In 122 iron pnictides, two-gap superconductivity is evident in the $H = 0$ spectra for all doping. The FT spectra for $H \geq 0$ exhibit ω and x-dependent QPI consistent with sign-changing s-wave pairing. [2]

[1]N.-C. Yeh and A. D. Beyer, Int. J. Mod. Phys. B **23**, 4543 (2009).
[2]M. L. Teague et al, Phys. Rev. Lett. **106**, 087004 (2011).